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# Biogas digester as an alternative energy strategy in the marginal villages in Indonesia

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**Abstract**

The purpose of this paper is to analyze the dominant factors using the biogas-digester in the poor villages as an alternative energy. The method of analysis is Qualitative approach. Using the informen or participants of ten people from BPPT and the people (farmers) who live in Gondosuli village – Pasuruan, this research finds that there are five dominant factors namely local wisdom, the spirit of championship, government financial support, green technology and strong informal leaders. The spirit of championship will produce anything that we will construct and implement in poor villages easily. The findings of the study are useful for administrators, project managers, and practitioners. This research does not discuss the business ethics, values, and the external and internal factors. This paper is a part of the research report which is financed by Ministry of National Education and Culture – Republic of Indonesia.



*Keywords:* Strategic; biogas; bio-digester; local wisdom; spirit of championship.

**Nomenclature**

| | |
|---|---|
| AD | Anaerobic digestion |
| APBN | Anggaran Pendapatan dan Belanja Negara (Government Budget) |
| APBN-P | Anggaran Pendapatan dan Belanja Negara – Perubahan (Government Budget-Revision) |

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| | |
|---|---|
| BPS | Badan Pusat Statistik (Statistics Centre Council) |
| BPPT | Badan Pengkajian dan Penerapan Technology (Applied Technology and Research Council) |
| BUFE | Brawijaya University – Faculty of Economics and Business |
| DME | Desa Mandiri Energy (Village Self-sufficient Energy Program) |
| GFS | Government Financial Support |
| LPG | Liquified Petroleum Gas |
| POAC | Planning, Organizing, Actuating, and Controlling |

## 1. Research background

Indonesian Act number 22/2011 [10] about National expenses and revenue budget (APBN) that signed by the president of Republic of Indonesia - Susilo Bambang Yudhoyono - on November 24, 2011 in Jakarta (President of Republic Indonesia) and documented on Goverment Sheet of Republic of Indonesia number 113/2011. There is one other problem on chapter 7 article 6 "The government will not increase the subsidized fuel price." The economic macro indicator for the ICP (Indonesian Crude Price) is USD 90. The ICP at the end of the March is USD 125 per barrel (1 barrel as 159,25 litre), but the government tries to increase the fuel price from Rp. 4.500 per litre to become Rp. 6.000, that makes citizens and students demonstrate against the government to refuse the increased of the fuel price ($1 = Rp. 9.300).

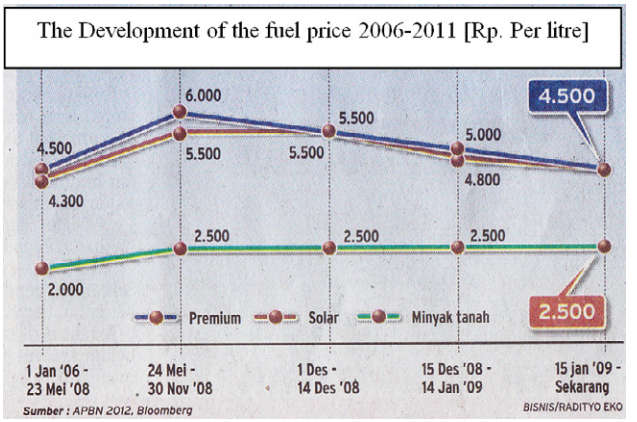
Figure 1 shows us the development of the fuel price in the year 2006 till 2011. The realization of the subsidized fuel Rp 74,7 trilliun divided by: subsidized for premium Rp. 36,6 triliun, kerozene is Rp. 13,7 triliun, and diesel oil (solar) Rp. 24,4 trilliun from Government revenue and budget – improvement (APBN-P) in the year 2010. Every year increased the fuel price except in the year 2009, but the subsidized for renewable energy is about Rp. 2,226 trilliun. The subsidized for renewable energy is relatively lower which means the planning of the mixed fuel (the combination of the 25% of renewable energy and 75% of the non renewable energy) will not be reached in the year of 2025.

The realization of the Liquefied Petroleum Gas (LPG) for three kg in 2012 is Rp. 123.599.674.000.000,00 or equivalent to 40.000.000 kilo litre (UU no. 22/ 2011 chapter 7 article 1). The total of the APBN is Rp. 1.435.406.719.999.000,00.

As the demand of the fossil fuel increases but the production of the lifting capacity and fuel stock decreases. The production of the crude oil is 944.000 barrel per day (bpd) in the year of 2009, but the target is 970.000 bpd in 2011 and the demand of the crude oil is 1.050.000 bpd, so the government should import from other country is about 85.000 bpd [8].

The total consumption of the solar (diesel oil) and premium (gasoline) in Indonesia is 14 million kilo litre in the year of 2008 or average 88.000.000 barrel per year or about 250.000 bpd. The target substitution of the fossil fuel to non fossil fuel is about 5% in 2010.

Figure 1 shows the fluctuation of the fuel (diesel oil, gasoline, kerosene) price. At the end of 2011 fuel price is lower than economic price. So the government might subsidize that fuel. The government financial support is about 30% of the National Expenses and Revenue budget, it means the financial support will be withdrawal from the budget for regional development budget (see Table 1).




Source: [9].

Fig 1. The development of the fuel price [Rp. per litre]

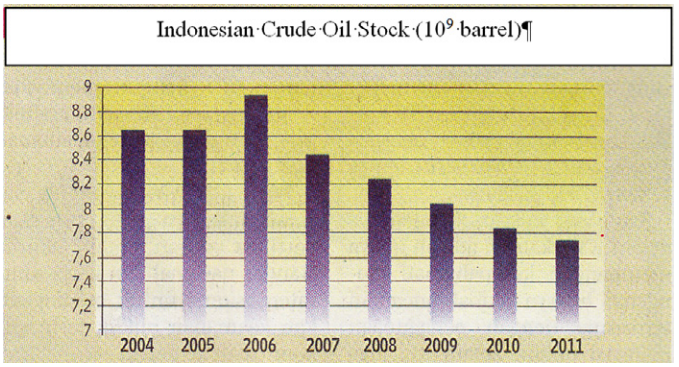
Table 1. The development of fuel subsidized (2007-2010)

| Types of Subsidy | 2007 | 2008 | 2009 | 2010 | |
|---|---|---|---|---|---|
| | | | | APBN | APBN-P |
| Total Fuel Subsidized ($10^{12}$ x Rp.) | 83.8 | 139.1 | 45.0 | 68.7 | 88.9 |
| 1. Fuel subsidized | 83.8 | 135.2 | 37.1 | 57.4 | 74.7 |
| • Gasoline | 25.3 | 43.6 | 15.2 | 24.3 | 36.6 |
| • Kerosene | 39.5 | 47.6 | 11.5 | 12.5 | 13.7 |
| • Diesel oil (solar) | 19.1 | 44.1 | 10.4 | 20.6 | 24.4 |
| 2. LPG subsidized | - | 3.9 | 7.9 | 11.4 | 14.7 |
| 3. Renewable Energy subsidized | - | - | - | 2.226 | 2.226 |
| Volume of Fuel and LPG | | | | | |
| Fuel Volume ($10^3$ x kl) | 38,643 | 39,176 | 37,723 | 36,505 | 36,505 |
| • Gasoline | 17,929 | 19,529 | 21,120 | 21,454 | 21,454 |
| • Kerosene | 9,850 | 7,885 | 4,569 | 3,800 | 3,800 |
| • Diesel oil (solar) | 10,864 | 11,792 | 12,035 | 11,251 | 11,251 |
| LPG ($10^3$ x kg) | - | 545,936 | 1,774,653 | 2,973,342 | 2,973,342 |

Source: [6].

Figure 2 shows that the national crude oil stock decreases dramatically. This stock cannot be fulfilled anymore in 2036, so the government needs to find the new or another alternative energy for example: bio-ethanol, bio-diesel, bio-gas or bio-energy. Or the government need the new type of energy like non fossil energy or renewable energy and has specific characteristics, i.e. decreased pollution and green technology also green wastes.

Most of the Indonesian people live in villages and they depend on the agriculture sector to drive the economic wheel. In the other side there are many agriculture product (e.g. leaf, paddy straw, sugarcane, slurry, sludge. etc) become wastes and not to many people concern about that. Actually the dried leaf and slurry can be used as an alternative energy.




Source: [9].

Fig 2. National Stock of crude oil (2004- 2011)

The slurry is one of the alternative energy also slurry can become the input of the specific equipment named biogas digester. This technology (bio-digester) is easier to build and can be used by individual or a group of people who have at the minimum of four cows in a certain village. The biogas-digester will produce gas methane (CH4) and can supply for daily cooking or other activities.

## 2. Literature study

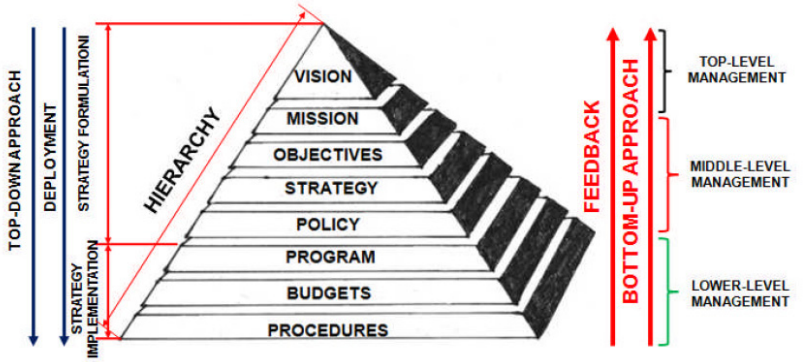
This chapter will discuss about the definition of the strategy, strategic planning, and bio-energy also bio-gas.

### *2.1. Strategy*

The terminology of strategy is strategos (Greek) which is the combination from two words “stratos” means “army” and “ago” means “leading/guiding/moving to”. So the strategy means the art of the militery operation planning and management in big scale and to direct to benefit position before the real battle with the enemy occurred. Wheelen [11] stated that “A strategy of a corporate forms a comprehensive master plan stating how the corporation will achieve its mission and objectives.”

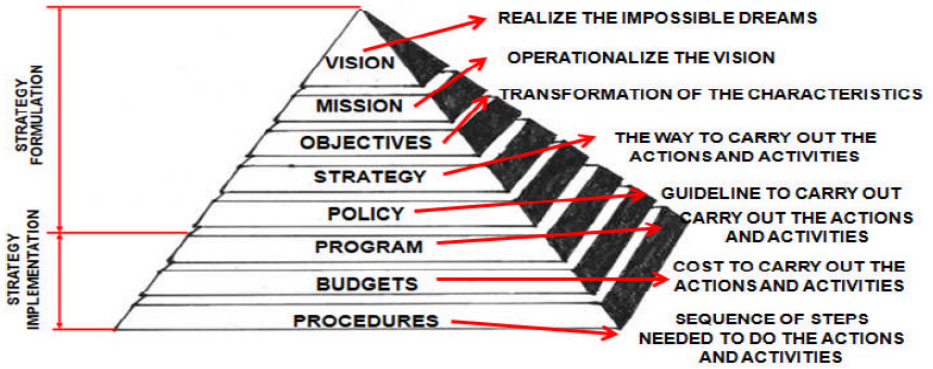
### *2.2. Strategic Planning*

The function of management consists of planning, organizing, actuating, and controlling (POAC). Strategic planning is a part of the planning function. Harold Koontz and Heinz Weihrich [3] stated that the strategic planning steps are Purposes or Missions, Objectives, Strategies, Policies, Procedures, Rules, Programs, and Budgets. In this paper the writer will discuss the BUFE methods or eight steps designing the strategic planning that anyone can design their own strategic planning using these eight steps. The steps are: Vision, Missions, Objectives, Strategies, Policy, Program, Budgets, and Procedures (see Figure 3). Figure 4 shows the terminology of each steps.




Source: [7]

Fig 3. The eight steps designing the strategic planning.




Source: [7].

Fig 4. The definition of each steps in strategic planning.

### *2.3. Bio-energy*

Bioenergy is renewable energy made available from materials derived from biological sources. Biomass is any organic material which has stored sunlight in the form of chemical energy. As a fuel it may include wood, wood waste, straw, manure, sugarcane, and many other by products from a variety of agricultural processes. Bioenergy is the energy extracted from the biomass, as the biomass is the fuel and the bioenergy is the energy contained in the fuel. Bjorn Zethraeus from Vaxjo University stated that "bioenergy is the energy that you extract from biomass so bioenergy can be electricitiy as produced from biomass. It can be heat as produced from biomass. So bioenergy is energy produced from biomass."

### *2.4. The Biogas (Anaerobic) Digester*

Anaerobic digestion (AD) involves the degradation and stabilization of organic materials under anaerobic condition by microbial organisms and leads to formation of biogas (a mixture of carbon dioxide and methane, a renewable energy source) and microbial biomass [12] (Yen Chen, 2007: 4044). Anaerobic digestion produces renewable energy from waste materials.

Table 2. Biogas composition

| Component | % |
|---|---|
| Methane (CH4) | 55-75 |
| Carbon dioxide (CO2) | 25-45 |
| Nitrogen (N2) | 0-0.3 |
| Hydrogen (H2) | 1-5 |
| Hydrogen sulphide (H2S) | 0-3 |
| Oxygen (O2) | 0.1-0.5 |

Source: [1].

Fabien Monnet [5] stated that biogas produced during anaerobic digestion is primarily composed of methane ($CH_4$) and carbon dioxide ($CO_2$), with amount of hydrogen sulphide ($H_2S$) and ammonia ($NH_4$) (see Table 2).

### *2.5. Energy Content*

Calorific value of one cubic meter of the biogas is equal to 6.000 watt hour or equal with half liter of diesel oil (solar). It means the biogas is suitable as an alternative energy in certain villages.

### *2.6. Fertilizer Produced by Waste of Biogas*

Biogas wastes or slurry is an organic fertilizer and rich of the component that the tree need. This element include: protein, cellulose, lignin, and etc that cannot be changed by artificial or chemical fertilizer. This organic fertilizer has already been applied in corn tree, garlic and paddy and succeeded significantly.

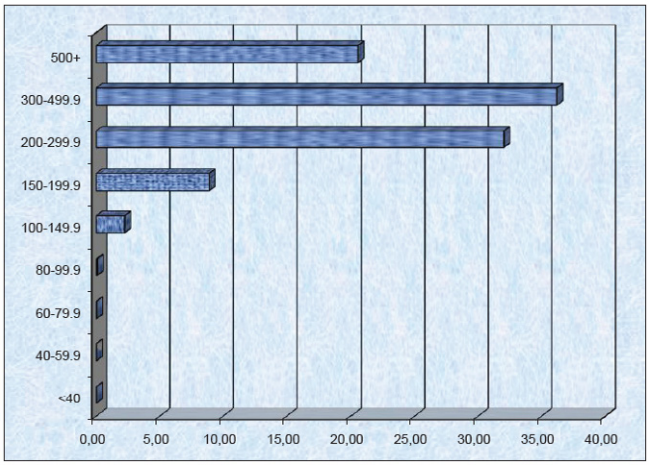
## 3. Research method (Case Study in Indonesia)

The method of analysis is qualitative approach using the informen or participants of ten people from BPPT and the people (farmers) who live in Gondosuli village - Pasuruan.

### *3.1. Village self-sufficient energy program*

The Indonesian government set up the Village Self-sufficient Energy Program (Desa Mandiri Energy/DME), the aim of which is to provide 2000 poor, remote villages with modern energy systems based on renewable materials that can be sustainably operated by the local community. By January 2009, however, only 430 villages had been electrified.

The purpose of the project is to improve the rate of implementation of the DME program and thus to contribute to the dissemination of renewable energy sources in rural regions of Indonesia. The quality of the implementation process is to be improved through a structured dialogue between all the involved parties including self-evaluations and independent evaluations. As a support, several studies will be prepared in order to identify examples of good practice and also to develop a uniform implementation structure as well as proposals for suitable technologies. The dialogue will be accompanied by a training program designed to boost the technological capacities of the implementation structures.




Source: [2]

Figure 5. Population percentage of monthly per capita consumption classes 2010

Implementation of the measures will speed up the realization of the DME program and thus the dissemination of renewable energies. Electrification of the villages will contribute to the economic development of the affected regions and will also create jobs.

### *3.2. Gondosuli village*

Jawa Timur province is one of the provinces in Java Island besides DKI Jakarta, Banten, Jawa Barat, Jawa Tengah and Yogyakarta. The area of Jawa Timur Province is about 45,963 $km^2$. It is divided completely into 38 lower level administrative areas that are defined as Regency or City. Jawa Timur consists of 29 Regencies and 9 Cities.

One of the regencies is Pasuruan Regency. Gondosuli (a remote area) village belongs to Puspo district and a part of Pasuruan Regency. More than 100 farmers live in Gondosuli village and they are good farmers but poor people [2].

Figure 5 shows that by class of per capita monthly expenditure, the largest percentage of population was that of Rp. 300,000 – Rp. 499,999 (36,20 percent) and the smallest percentage of population was that of Rp. 40,000 – Rp. 59,999 (< 1 percent).

## 4. The research result

The research result finds that there are five dominant factors which are:

- Local wisdom,
- Spirit of the championship,
- Strong informal leader,
- Government financial support, and
- Green technology.

### *4.1. Local wisdom*

A certain village (remote) needs a person who can lead the other people and who can interprete what the people need and can function as a good mediator. And that leader has specific tasks, i.e. to socialize and to explain to the people to realize any projects from the government or individuals or a group of people.

### *4.2. The spirit of championship*

A certain village (remote) need a person who has strong mental and has champion spirit. Someone who starts alone, uses his/her money, effort, and hands well as strong ability to realize his/her idea to become true.

### *4.3. Strong informal leader*

A certain village (remote) needs a person who could influence the other people (followers) to implement and work together to realize his/her idea.

### *4.4. Government financial support*

GFS has two types, there are loans or grant. The government should give the specific loans the people in remote villages, and people are required to pay back the loan, possible with lowest interest. And the government should give specific grants to motivate the people in remote villages as a trigger, and the people are not required to pay back the grant. The government must evaluate and monitor the loans and grants.

### *4.5. Green technology*

Green technology (abbreviated as greentech) or environmental technology (abbreviated as envirotech) or clean technology (abbreviated as cleantech) is the application of one or more of environmental science, green chemistry, environmental monitoring and electronic devices to monitor, model and conserve the natural environment and resources, and to curb the negative impacts of human involvement.

A reactor will process the raw materials (e.g. seeds of Jatropha, corn, palm, singkong, bintaro, by product of sugarcane factory, biogas, biomass, etc) to become the renewable energy. The selection of that technology should be appropriate, using high efficiency, clean, and produce lower pollution.

## 5. Conclusions

The government roles are to support to increase the production of the alternative energy, especially to build amount number of the bio-digester units in villages. The government should concern and apply some dominant factors namely local wisdom, the spirit of the championship, strong informal leader, government financial support, and green technology.

## Acknowledgements

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